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HABITAT USE AND FORAGING BEHAVIOR OF TOWNSEND'S BIG-EARED BAT (*CORYNORHINUS TOWNSENDII*) IN COASTAL CALIFORNIA

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Radiotracking studies of Townsend's big-eared bat (*Corynorhinus townsendii*) were conducted in grazed grassland and coastal forest (California bay, Douglas-fir, and redwood) at Point Reyes National Seashore in coastal central California. Radiotagged bats were used to determine the foraging patterns of both female and male bats and to locate alternate roost sites. The animals showed considerable loyalty to their primary roost sites even though the study was conducted after the nursery period had ended, when the bats would normally be dispersing for the season. Foraging patterns differed between male and female bats, with females traveling greater distances than males. Males consistently stayed close to the maternity colony both during day and night. Both sexes flew in the immediate vicinity of vegetation, both when foraging and when traveling from the roost to foraging areas. Foraging activity was concentrated primarily along the edges of riparian vegetation.

Key words: bat, Chiroptera, *Corynorhinus townsendii*, foraging, habitat use, radiotelemetry, roost sites

Corynorhinus townsendii is a rare bat throughout its range in North America. The 2 eastern subspecies, *C. t. ingens* and *C. t. virginianus*, are federally listed as endangered; the 2 western subspecies, *C. t. townsendii* and *C. t. pallescens*, are currently considered federal species of concern (formerly category 2 candidates) by the U.S. Fish and Wildlife Service. Whereas Handley (1959) outlined a large zone of intergradation between the 2 western subspecies, he described *C. t. townsendii*as primarily a coastal form with a limited distribution.

Point Reyes National Seashore supports 2 of only 6 known colonies of *C. t. townsendii* along the coast of California (Brown et al. 1994; Pearson et al. 1952; Pierson and Rainey 1996). Although *C. townsendii* is primarily a cavity-dwelling bat, with most known roost sites being located in caves or mines (Clark and Clark 1997; Dobkin et al. 1995; Humphrey and Kunz 1976; Kunz and Martin 1982; Lacki et al. 1994; Sherwin et al. 2000), all known maternity sites along the California coast are in anthropogenic structures (5 in attics of old buildings and 1 in a cave-like feature of a bridge). The study colony has occupied an abandoned ranch house in the Olema Valley of Marin County since at least 1987.

Because maternity colonies form clusters on open surfaces (Pearson et al. 1952) and have relatively restrictive roost requirements (Humphrey and Kunz 1976; Perkins and Levesque 1987; Pierson et al. 1991; Sherwin et al. 2000), human disturbance of roosts, particularly recreational caving, has long been acknowledged as a significant threat to this species (Graham 1966; Humphrey and Kunz 1976). Far less is known

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regarding foraging requirements and the extent to which foraging habitat might limit populations.

Studies on foraging behavior and habitat use for the 2 eastern subspecies have shown that they are lepidopteran specialists (V. Brack, Jr., V. Dalton, and C. Williams, in litt.; Burford and Lacki 1998; Dalton et al. 1986; Ross 1967; Sample and Whitmore 1993) that forage in a variety of habitats, including edge habitats along intermittent streams; old fields; open areas of pastures, crops, and native grass; the proximity of woodlands; and in association with forests (Burford and Lacki 1995; Clark et al. 1993; V. Dalton, in litt.; Sample and Whitmore 1993). Although a preference for moths is documented for western populations (Whitaker et al. 1977, 1981), far less is known regarding foraging habitat. Brown et al. (1994) observed a coastal California population of *C. townsendii* foraging in native oak (*Quercus*) and ironwood (*Olneya tesota*) forest. Dobkin et al. (1995) radio-tracked foraging individuals to sagebrush shrubsteppe and open ponderosa pine woodland in central Oregon. Kuenzi et al. (1999), Ports and Bradley (1996), and Sherwin et al. (2000) note an affinity for pinyon pine (*Pinus monophylla*) and juniper (*Juniperus osteosperma*) habitat in Nevada and Utah.

The purpose of our study was to investigate foraging behavior and to identify alternate roost sites of a coastal colony of *C. townsendii*. The study area offered a good opportunity to evaluate habitat use because the valley in which this colony dwells is composed of clearly delineated habitat types, with relatively intact coastal forest on the western slope and heavily grazed grassland interspersed with vegetated gullies on the eastern slope.

Materials and Methods

Study area.—The study was conducted in the Olema Valley (Marin County, California, 37°58′45″N, 122°44′7″W), a 38-km² area managed by Point Reyes National Seashore, about 35 km N of San Francisco. The valley is approximately 11 km long and is oriented north–south along the San Andreas Fault zone. A maternity roost of *C. townsendii* occupies the attic of an abandoned 2-story ranch house (constructed in the 1880s), the last remaining building from the original ranch complex. The house was vacated in 1974 and has been occupied by a *C. townsendii* maternity roost for more than 15 years. Approximately 200 females occupy the house for 8–10 months each year. The nearest known maternity roost is 6.6 km to the SW where another colony of approximately 200 female *C. townsendii* occupies the attic of an old barn-like building.

The ranch house roost is located in the center of Olema Valley, <100 m from a perennial creek that bisects the valley. Additional water is available from a number of ponds within the valley and several large reservoirs <10 km to the east.

The Olema Valley has been subjected to a number of perturbations, including beef cattle ranching since the 1840s, dairy ranching in the 1850s–1960, periodic fires, and clear cut logging. Nonetheless, much of the native habitat either persists or has regrown.

The east side of the valley is about 75% grazed grassland. Slopes are bisected by 21 small drainages with both intermittent and perennial streams that support narrow woodland corridors composed of riparian vegetation and California bay (*Umbellularia californica*). Beyond the valley to the east is second-growth redwood (*Sequoia sempervirens*) forest on lands protected by the Marin Municipal Water District. Water district lands have been extensively modified by the combined effects of a large wild fire in 1945 and a clear-cut logging operation from 1945 to 1952.

The west side of the valley is mostly second-growth Douglas-fir (*Pseudotsuga menziesii*), with California bay in moister canyon bottoms, and a few second-growth redwoods. Though there was some hand logging in the late 1800s, the forest persisted well into this century. An extensive logging operation in the 1950s removed most of the larger Douglas-fir trees from the valley; however, a few seed trees testify to the nature of the forest in years past. Beyond the valley to the west is a mosaic of Douglas-fir and coastal scrub that extends down the slope to the Pacific Ocean.

Light tagging.—On 27 September 1989 we captured bats with mist nets as they left the ranch house roost. Twenty-one bats were outfitted with a chemiluminescent tag (Buchler 1976). The tags were made by blowing glass balls from a 3-mm diameter glass tube. Tags ranged from 5 to 9 mm in diameter with a 4-mm-long stem filled with silicone rubber. The tags were injected with activated fluid from a cylume flare that glowed for 6–8 h. The resulting tags weighed 0.25–0.45 g, well within the 5% recommended weight limit (Aldridge and Brigham 1988).

Tags were attached to the middorsal hair over the scapulae with SkinBond® surgical adhesive. Only a small amount of adhesive was used, so that the tag would fall off within 1–2 days. Tags were visible to the unaided eye at <100 m, especially when bats were moving. Observers occasionally used either binoculars or night vision equipment to facilitate behavioral observations.

Light-tagged bats were tracked for 1 night by 22 observers stationed within 2 km of the roost. Each observer had a 2-way radio and was in constant contact with a permanent base station as well as with most observers. A cassette tape recorder at the base station made a permanent record of all radio transmissions. The resulting tapes were transcribed for analysis.

Radiotracking.—On 15 September 1997, 13 postlactating females, 1 nonreproductive adult female, and 3 adult males were captured in mist nets and a harp trap as bats left the roost during the evening. The heaviest individuals (n = 17) were outfitted with 0.44-g radiotransmitters (Model LB-2, Holohil Systems Ltd., Carp, Ontario, Canada) and followed for 10 days and nights. The transmitters weighed between 3.5% and 4.7% body mass, less than the 5% recommended maximum (Aldridge and Brigham 1988). Transmitters were attached to bats by trimming middorsal hair between the scapulae and applying SkinBond® surgical adhesive to the underside of the transmitter.

Each evening, for 7 nights, 6–9 observers were stationed at various high points throughout the Olema Valley and along adjacent ridge tops. Several stations were used every night whereas others were occupied for only 1 or 2 nights, in an attempt to determine whether bats were in the vicinity. A total of 16 sites were used as observation posts throughout the study.

Each night, some observers tracked bats from fixed stations. Other observers were assigned the task of following a specific bat continuously. Success in following a bat depended on how far and fast the bat moved and whether there were roads or trails in the vicinity of the bat's activity. These mobile observers were often able to position themselves at the sharp demarcation between open grassland and riparian vegetation, so that they could determine where transmittered bats were foraging.

The main roost was visited by observers each day to determine which bats had returned. We tried to locate bats that were not present at the house by driving along the main road through the valley and on dirt roads along adjacent ridges, as well as by aerial survey from a small aircraft. When a signal was detected for a missing bat, we attempted to locate the alternate roost site. After the initial 7-day tracking period, bats were radiotracked during the day to obtain additional information on roost site fidelity and alternate roost sites.

Telemetry data were analyzed by plotting observations on digitized USGS topographic maps (1:24,000 scale) using Topo! mapping software (Wildflower Productions, San Francisco, California). When observers were <50 m from a bat, they plotted the location directly on a 7.5′ map in the field. Observers at fixed locations recorded the time, azimuth, and a subjective evaluation of signal strength each time a bat was detected. Since observers were in radio communication, it was often possible to synchronize observations. Locations for these bats were determined by plotting the intersection of simultaneous azimuths.

RESULTS

Dispersal from the day roost.—Radiotransmittered bats emerged at 2016 h ± 20 min *SD*, approximately 60 min after sunset. Radiotelemetry data showed that individual bats traveled <10.5 km from the day roost and tended to return to the same areas to forage each night. There was a significant difference between the distance female bats traveled each evening and distance traveled by males. The center of activity for females was 3.2 ± 0.5 km from the roost whereas the mean center for males was 1.3 ± 0.2 km (P = 0.033, $d.f.$ = 13). Relative lack of movement by males was typified by male #15, for which we have the most extensive observations. This bat never moved >1.7 km from the original capture site, and most of its activities were <1.0 km from the ranch house.

Foraging flight patterns.—Light-tagged bats foraged predominantly around the perimeter of trees, although bats were occasionally observed flying amongst the outermost limbs. When bats foraged around bushes, their flight pattern followed the contour of the vegetation, similar to their behavior around trees.

Foraging flight was slow and leisurely, often appearing methodical. Most often, there were large, almost perfectly horizontal 3- to 10-m sweeps back and forth. Sometimes bats followed a horizontal figure-8 pattern. After 1 or 2 sweeps, a bat would typically move 0.5–1.0 m higher and continue with more sweeps. Less commonly, the bat would move closer to the ground in successive sweeps. Occasionally, we observed bats flying under the lower branches of a tree, using slow vertical movements. One bat dipped in and out of openings in the vegetation as it flew along a mostly horizontal path.

Corynorhinus townsendii did not hover or obviously pause as would be expected if it were gleaning. One of us (EDP) was able to follow a light-tagged bat with night vision goggles as it foraged on flying moths (Dioptidae) near and within the canopy of a coast live oak (*Quercus agrifolia*).

Habitat use.—Light-tagged bats typically followed the edge of the forest, often along riparian corridors where vegetation was predominantly Douglas-fir, California bay, and occasionally willows (*Salix*). They usually flew 10–30 m off the ground between midcanopy and near the top of the canopy. Bats appeared to reduce their time in open areas. They followed streams up valleys, hugging the tree canopy, and their flight was fast and direct.

Radiotracking data also suggested that bats spent the majority of their time near riparian vegetation (trees, shrubs, and bushes). Fig. 1 shows all areas where bats were found during 11 days of radiotracking. Bats favored riparian habitat along streams and smaller tributaries. This close association was accentuated by the surrounding habitat of open grassland. Occasionally bats were found in more open habitats, typically in close association with scattered trees or large shrubs. This trend was true for both males and females.

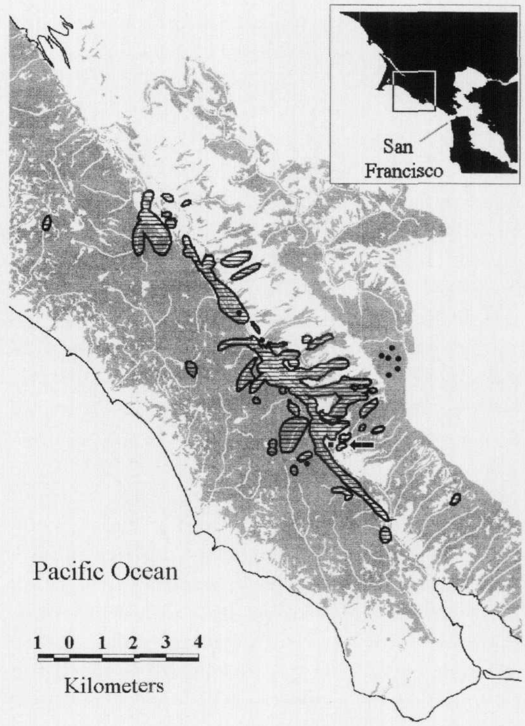

FIG. 1.—Cumulative foraging areas (hatched) for 13 postlactating female, 1 nonreproductive adult female, and 3 adult male *C. townsendii* with radiotransmitters in Olema Valley, Marin County, California. Ranch house where bats were captured is noted by a black square, indicated with an arrow; shaded area represents forest, unshaded area represents grassland, and black dots are alternate tree roosts used during the telemetry study. Inset map shows location of the study area, about 35 km N of San Francisco, California.

Bats avoided open grassland, both when foraging and when traveling between the roost and foraging areas. When crossing open grassland, bats dropped down to a

TABLE 1.—Activity of a male *C. townsendii* (#15) that was tracked nearly continuously on 17 and 18 September 1997 and activity of a female *C. townsendii* (#7) that was tracked 18 September 1997, shown as time activity began and (where known) ended.

Male #15						Female #7		
17 September 1997			18 September 1997			18 September 1997		
Start (h)	End (h)	Activity	Start (h)	End (h)	Activity	Start (h)	End (h)	Activity
—	1950	Day roost		1959	Day roost	—	2007	Day roost
1950	2012	Foraging	1959	2005	Foraging	2007		Flying
2013	2034	Foraging	2005	2006	Traveling	2014		Flying
2034	2247	?	2006	2013	Foraging	2038		Flying
2247	2300	Foraging	2013	2027	Foraging	2052		Flying
2300	2302	Traveling	2028	2029	Foraging	2100		Flying
2302	0002	Roosting	2029	2032	Foraging	2102	2105	Foraging
0002	0009	Foraging	2032	—	Traveling	2105	2106	Traveling
0009	0012	Traveling	2042	—	Roosting	2106	2111	Foraging
0012	0019	Foraging	2044	2048	Foraging	2111	2130	Foraging
0019	0034	Foraging	2048	2050	Foraging	2130	2132	Foraging
0035	0114	Roosting	2051		Foraging	2132	2134	Traveling
0114	0121	Foraging	2056		Roosting	2134	2146	Foraging
0121	0227	Foraging	2214		Roosting	2146	2202	Foraging
0227	0245	Roosting	2356		Roosting	2203	2213	Foraging
0245	0252	Foraging	0019		Roosting	2214		Roosting
0252	0256	Foraging	0036		Roosting	0145		Foraging
			0053		Roosting			
			0330		Roosting			

height of about 1 m from the ground. This initial downward movement was distinctive and described by observers as either a vertical plunge or a sharp drop. Flight across the open grassland was always fast and usually in a straight line, but occasionally it was erratic or jerky.

Activity periods.—We obtained activity data on all bats. The most extensive data, however, were obtained for 2 individuals (bats #15 and #7). Male #15 was followed nearly continuously for significant portions of 2 nights (Table 1). On 17 September, he left the roost at 1950 h. With the exception of one 73-min gap (Table 1), we were able to track the bat continuously until 0252 h. The bat was flying (presumably foraging) 67% of the time. During the rest of the time, the bat roosted. While the exact roost site was not located, the bat was in a woodland with both California bay trees and Douglas-fir. No manmade structures or caves were in the immediate area.

The following night, bat #15 spent considerably less time in flight. It flew most of the 1st hour, moving between various areas as it had the night before. At 2042 h it roosted for <10 min before resuming flight. The bat was found roosting at the ranch house during all the checks from 2056 to 0330 h.

Bat #7 was the only female that we tracked for a nearly continuous period (Table 1). On 18 September, this bat flew continuously from emergence at 2007 h until 2214 h, when it returned to roost at the ranch house.

Based on these 2 bats, and on less detailed observations of others, it appears that there is a period of about 1 h when the bats fly continuously or nearly so. After that, behavior is highly variable, both between bats and for individual bats on consecutive nights. This variability was not obviously related to weather, as there was little change in weather patterns during the study.

Roost fidelity and alternate day roosts.—Between 41% and 88% of the bats returned

TABLE 2.—Roost-site fidelity after trapping and application of radiotransmitters. Day roosts are coded as M = bat roosted at original maternity roost, Redw = bat roosted in a redwood tree, Bay = bat roosted in a California bay tree, Barn = bat roosted at a barn, blank = bat roosted at unknown day roost. Female bats were all postlactating (PL) except bat #14 (non-reproductive, NR). Male bats were all scrotal (S).

	Bat number	Days after tagging 1	2	3	4	5	6	7
Female								
PL	1		M	M	M	M	M	M
PL	2		Barn	Barn	Barn	Barn	M	
PL	3		M		M	M		
PL	4		M		M	M	M	M
PL	5		M	M	M	M	M	M
PL	6	M	M		M	M	M	
PL	7	M	M		M	M	M	
PL	8	M	M	M	M	M	M	M
PL	9	M	M	M	M	M	M	M
PL	10				M	M		M
PL	11	M	M	M	M	M	M	M
PL	12		M		M	M		
PL	13	M	M	M	M	M	M	M
NR	14	M	M	M	M	M	M	M
Male								
S	15	M	M	Bay	M	M	M	M
S	16	M	M		M		M	
S	17		Redw	Redw	Redw	Redw		
Return rate		53%	82%	41%	88%	82%	76%	65%

each day to roost at the ranch house, but the pattern was quite variable (Table 2). Of the 17 bats with transmitters, only 53% (2 of 3 males, 7 of 14 females) returned to the maternity roost the day after being fitted with a transmitter. All females with transmitters returned to the roost during the study; 5 females were found in the roost on each of the 7 days following capture. One male bat never returned to the ranch house during the study and 1 female was found at the house on only day 6 after tagging.

We located 9 alternate day roosts. One was an old wood-frame storage building that was part of an active ranch complex. The building was 1-story with a floor size of approximately 8 by 10 m. It had several openings through which a bat could easily fly. Visual inspection indicated that the radiotagged bat was the only individual roosting in this structure.

All other roosts were in basal tree hollows, 2 in California bay trees, and 6 in redwood trees. The bay tree used by bat #15 (Table 2) was in a riparian zone, 0.9 km from the original capture site. The tree was the largest bay in the area, clearly standing out as the matriarch. The tree hollow was formed by rotting at the base. Though the hollow was moderately dark, it allowed more light in than the redwood tree hollows. In 1983, a male bat was found day roosting in a similar bay tree, 4.4 km NE of the ranch house. The tree was in a riparian zone, and the basal part of the trunk was almost entirely hollow. Whereas the opening was 0.4 by 0.9 m high, the interior space was 1.2 m by 3.0 m in height.

The 6 redwood tree roosts were just over a ridge to the east of Olema Valley, 2.3–2.6 km from the ranch house. The roost trees ranged from 1.15 to 1.94 m diameter at breast height and were among the larger trees in the forest.

The redwood basal hollows had all been created by fire. On average, the openings faced toward the south (171.4°, range 70–254°) and were 0.7 m by 2.6 m high (range 0.3–1.8 m width, 0.8–4.3 m height). The inside hollow averaged 0.9 by 3.0 m high (range 0.4–2.2 m width, 1.5–4.5 m height). Hence, the hollow extended up into the tree higher than the external opening, as is typical of fire scars in redwoods. Interiors were conspicuously dark, largely due to the charred blackened wood. With 1 exception, all redwood day roosts were used by males. In each case, the radiotagged bat was the only individual roosting in the trees.

Discussion

Flight and foraging patterns.—Commuting distances of bats in this study are consistent with those found in other studies of this species, both in California and in the eastern United States (Adam et al. 1994; Brown et al. 1994; Clark et al. 1993; Pierson 1998). Distances traveled between roosts and foraging areas vary among species, with some foraging within a few kilometers of their roosts (Brigham 1991; Entwistle et al. 1996; Kronwitter 1988) and others traveling 10–30 km to foraging areas (Krull et al. 1991; Pierson 1998; Shiel and Fairley 1999; Vaughan 1959). The expectation, based on wing morphology (Norberg and Rayner 1987), would be that those species with high wing loading and high aspect ratios (e.g., the molossids) would be better adapted for long distance flight, and those with low wing loading and low aspect ratio suitable for hovering (e.g., a number of *Myotis* species) would forage closer to their roost sites. Whereas the wings of *C. townsendii*, with low wing loading and a low aspect ratio, are adapted for hovering and foraging close to or within clutter (Norberg and Rayner 1987), in this study and others (Adam et al. 1994; Brown et al. 1994; Clark et al. 1993; Pierson 1998), maximum one-way distances are relatively large (5–13 km).

Commuting distances may also vary among individuals and within species depending on a number of variables, including season (Dobkin et al. 1995), sex (Entwistle et al. 1996), reproductive condition (Catto et al. 1996; Clark et al. 1993), and availability of suitable foraging habitat (Catto et al. 1996). Although Brown et al. (1994) found no differences in distances traveled between males and postlactating females on Santa Cruz Island in southern California, female bats (postlactating and nulliparous) in our study consistently traveled farther from the roost than males. Adam et al. (1994), in a study of *C. t. virginianus*, found that late in the season, postlactating females traveled greater distances than they had earlier in the season (when pregnant and lactating). Though Adam et al. (1994) had a small sample size, their data suggest that late in the season females may travel greater distances than males. The tendency for males to remain in close proximity to the maternity roost in our study may be because males were in breeding condition and thus likely vying for access to females. We have no information on whether the distances traveled by females differ seasonally in our study population. It is possible, however, that postlactating females were traveling large distances to leave foraging areas closer to the roost available to the young. A study of foraging behavior in *Myotis lucifugus* showed that when population densities were high, adult females shifted their foraging areas to more cluttered environments, leaving uncluttered feeding areas to newly volant young (Adams 1997).

Norberg and Rayner (1987) place *C. townsendii* in a hovering–gleaning feeding class, based on wing morphology. It has also frequently been presumed that bats with long ears forage by gleaning nonairborne prey from surfaces (Hill and Smith 1984; Humphrey et al. 1983; McNab 1971; Wilson 1973). Fenton (1990) suggests, however, that there are no species known to forage exclusively by gleaning, and studies conducted on presumed gleaners often reveal a more flexible feeding strategy (Arlettaz 1996; Faure and Barclay 1994; Krull et al. 1991). Another long-eared plecotine species, *Euderma maculatum*, is apparently not a gleaner (Leonard and Fenton, 1983; Wai-Ping and Fenton, 1989). Howell (1920) described *C. townsendii* as taking insects from leaf surfaces, and studies have shown that the morphologically similar European sister taxon, *Plecotus auritus*, takes approximately 50% of its prey by gleaning (Swift 1998). Whereas our observations of light-tagged bats support earlier descriptions of *C. townsendii* as a highly maneuverable and agile flier (Barbour and Davis 1969; Dalquest 1947) and reveal animals flying and foraging in close proximity to vegetation, they do not include any observations of gleaning.

Habitat use.—Recent radiotracking and light-tagging studies have found *C. townsendii* foraging in a variety of habitats. The eastern subspecies forages over open pasture, corn and alfalfa fields, and around the crowns of trees in Virginia (V. Dalton, V. Brack, Jr., and C. Williams, in litt.); along the edges of intermittent streams (Clark et al. 1993), over pasture and rangeland, in the forest, and along the forest edge (Wethington et al. 1996) in Oklahoma; and along canyon walls and cliff faces (Adam et al. 1994; Burford and Lacki 1995; Caire et al. 1984) and over small old fields (Burford and Lacki 1995) in Kentucky and Oklahoma. The western subspecies have been radiotracked foraging in native oak and ironwood forest on Santa Cruz Island in California (Brown et al. 1994) and in sagebrush steppe and open ponderosa pine parkland in central Oregon (Dobkin et al. 1995).

In our study of *C. townsendii* in coastal California, the primary foraging habitat appeared to be riparian woodland. The animals followed densely vegetated gullies when dispersing from the main roost, and spent the majority of their foraging time within a forested habitat. Although they clearly used forest-edge habitat, they appeared to avoid the grazed grasslands.

It is possible that grazing reduces foraging habitat for *C. townsendii*. Whereas this species is reported to forage over old fields and agricultural fields in the East (V. Brack, Jr., V. Dalton, and C. Williams, in litt.; Burford and Lacki 1995; Wethington et al. 1996), we saw no evidence in either light-tagging or radiotracking studies that this species foraged over grazed grasslands. Because our study area did not include any areas of ungrazed grassland, we cannot determine whether the foraging patterns we observed could best be explained by a preference for forested gullies or by an avoidance of grazed areas. Entwistle et al. (1996) described a similar reluctance by *P. auritus* to fly in open areas and suggested that flying in association with vegetation may offer protection from aerial predators. When commuting, species such as *C. townsendii*, with echolocation calls of limited range, may rely on landscape features for orientation, perhaps even using vegetation for opportunistic feeding en route to primary foraging areas.

Roost fidelity and alternate day roosts.—Whereas the majority of known roosts for *C. townsendii* are caves or structurally similar sites such as abandoned mines (Barbour and Davis 1969; Clark and Clark 1997; Clark et al. 1996, 1997; Dobkin et al. 1995; Genter 1986; Graham 1966; Humphrey and Kunz 1976; Lacki et al. 1994; Marcot 1984; Rippy and Harvey 1965; Sherwin et al. 2000; Wethington et al. 1997), along the Pacific coast this species frequently roosts in buildings (Brown et al. 1994; Dalquest 1947; Nagorsen and Brigham 1993; Pearson et al. 1952), generally in open attics.

Although *C. townsendii* shows little fidelity to interim roosts (Dobkin et al. 1995), it tends to be highly loyal to maternity sites. Banding studies have shown females returning to the same roost year after year (Pearson et al. 1952), and certain roosts, particularly caves, are predictably occupied by maternity colonies over a number of years, or even centuries (Graham 1966). Some colonies may use more than 1 roost during the nursery season (Sherwin et al. 2000) or move within the same roost in an apparent response to microclimatic needs at different times during the maternity cycle (Pierson et al. 1991). The abandoned ranch house used by the study colony has been occupied every year from April until October since the colony was discovered in 1987. It likely has been used each year since the house became vacant in 1974, about the same time that a *C. townsendii* colony was excluded by renovation from another building a few kilometers to the north.

Our radiotracking data further demonstrate a high degree of loyalty to this roost site (Table 2). Although 1 bat abandoned the roost for 7 days after being outfitted with a transmitter, 7 of the 14 females were in the roost the next day, and 10 females used the roost throughout the entire study. Because mid-September is the time when *C. townsendii* begins to disperse from the maternity roost, the disturbance of capture may have caused several to depart somewhat earlier than normal. Interestingly, no radiotagged bats from this colony were found at a *C. townsendii* maternity roost 6.4 km away. Because our study was conducted in mid- to late-September, and mating begins as early as early October (Pearson et al. 1952), it was not surprising to find some males roosting in the building.

We provide the first documented use of tree roosts by *C. townsendii* and suggest an association between this species and large-diameter hollow redwood trees along the coast. Recent radiotracking studies have documented extensive use of tree roosts by a number of North American bat species (Barclay and Brigham 1996), including the sister taxon, *Corynorhinus rafinesquii* (M. K. Clark, in litt., http://www.mesc.usgs.gov/BPD/ireport.htm; Lance et al. 2001). Use of basal hollows in fire-scarred redwoods was first documented for pallid bats, *Antrozous pallidus*, in 1947 (Orr 1954). More recent studies have shown that these basal hollows are used extensively (Gellman and Zielinski 1996; Rainey et al. 1992; Zielinski and Gellman 1999), especially by *A. pallidus* and *Myotis yumanensis* (Rainey et al. 1992). It is possible that *C. townsendii* historically relied upon this resource for roosting. The loss of >90% of old-growth redwood forest along the coast may help explain the apparent reliance upon anthropogenic structures by coastal populations of *C. townsendii*. Four of the colonies known along the central coast of California are in close proximity to remnant redwood forest, suggesting that this habitat may be important for foraging or roosting or both.

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